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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/829,136	04/21/2004	Hee-hwan Choe	8116-1 (PL0026/US)	5461

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EXAMINER	
DHINGRA, RAKESH KUMAR	

ART UNIT	PAPER NUMBER
1763	

DATE MAILED: 07/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/829,136	CHOE ET AL.	
	Examiner	Art Unit	
	Rakesh K. Dhingra	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *03* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 May 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 3-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 7 recites the limitation " wherein the mixed voltage comprises E1cos(w1t) for generating plasma and EI+(E2-EI) cos(w2t) for adjusting etching conditions when the main frequency is substantially larger than the bias frequency in line 20 of the claim. There is insufficient antecedent basis for this limitation in the claim since E1, E2, W1, W2, and t are not defined in the claim.

Claim Objections

1) Claim 4 is objected to under 37 CFR 1.75 as being a substantial duplicate of claim 3. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

2) Claim 6 is objected to under 37 CFR 1.75 as being a substantial duplicate of claim 5. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Response to Arguments

Applicant's arguments with respect to claims 1, 3-6, 7 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended independent claims 1, 7 and also amended dependent claims 3-6 for dependency.

New reference has been found (US PGPUB 2003/0049558- Aoki et al) that when combined with Quon et al reads on limitations of claims 1-7. Accordingly claims 1-7 have been rejected under 35 USC 103 (a) as explained below.

Further, reference (US PGPUB 2003/0049558- Aoki et al) when combined with Wikuramanayaka reads on limitations of claims 1 and 3-6. Accordingly claims 1, 3-6 have been rejected under 35 USC 103 (a) as explained below. Claim 7 has also been rejected under 35 USC 103 (a) as explained below.

Additionally, reference (US PGPUB 2003/0049558- Aoki et al) when combined with Donohoe et al reads on limitations of claims 1-7. Accordingly claims 1, 3-7 have been rejected under 35 USC 103 (a) as explained below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not

commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 3-7 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Quon et al (Pub No. US 2003/0094239 A1) in view of Aoki et al (US PGPUB No. 2003/0049558).

Regarding Claim 1: Quon et al teach a plasma apparatus 20 (Figure 3A) comprising a process chamber with a wafer supporting chuck (Lower electrode)18;

a very high frequency generator 14 and a VHF match network 30;

a low frequency RF generator 16 (for bias) and a low frequency RF match network 32;

a combiner circuit (mixer) 34 connected to first and second impedance matching networks 30, 32 and receives and mixes the main and bias voltages and outputs the mixed voltage to lower electrode 18 (Paragraphs 0022, 0023, 0024).

Quon et al do not explicitly teach upper electrode, but teaches that the apparatus can be a capacitively coupled or inductively coupled plasma reactor (would have an upper electrode).

Quon et al do not teach an auxiliary power supply comprising an auxiliary power source and a third impedance matching circuit.

Aoki et al teach a plasma apparatus (Figures 1C, 14A) that includes a plasma reaction container 502 and upper electrode 103 to which RF power is supplied. Aoki et al further teach that apparatus includes three power sources 110A, 110B, 801 (like main, bias and auxiliary power supplies) and three corresponding matching networks 112A, 112B and 802 whose output power having predetermined frequencies and amplitudes is synthesized (mixed) and then branched and supplied to upper electrode 103 (paragraphs 0533 –0537).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to mix power from three power sources with three matching networks and supply mixed power to one of the electrodes as taught by Aoki et al in the apparatus of Quon et al to achieve improved evenness of standing wave suppression effect (paragraphs 0081, 0082).

Regarding Claims 3, 4: Quon et al teach that combiner circuit (mixer) 34 outputs the mixed voltage by adding the received voltages (paragraph 0024).

Regarding Claims 5, 6: Quon et al teach that frequency of RF generator (bias) 16 is lower than the frequency of VHF generator (main frequency) 14 [paragraph 0028].

Regarding Claim 7: Quon et al in view of Aoki et al teach all limitations of the claim as explained above, including filters in the combiner circuit (mixer) 34 that prevent the main

power source and the bias power source from being directly connected to the lower electrode for simultaneously supplying AC power from the main and bias power sources to the lower electrode (Quon et al - Paragraph 0024). Additionally, Aoki et al also teach (Figure 1C) that filters 331, 332, 333 can be used to prevent the power from one power supply diffract into other power supply (paragraphs 0106-0110). Further, the output voltage of mixer would inherently include a portion for generating plasma that would depend upon the amplitude and frequency of the main voltage and another portion for adjusting the process (etching) condition as per equation given on page 9, lines 2, 3 of the specification.

Claims 1, 3-7 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Wikuramanayaka (JP Pub. No. 2002-246368) in view of Aoki et al (US PGPUB No. 2003/0049558).

Regarding Claim 1: Wikuramanayaka teaches a plasma processing apparatus (Figure 1) comprising:

a reaction container (processing chamber) 10 with an RF (lower) electrode 16 and a gas installation plate (grounded showerhead -like upper electrode) 18;

a first RF generator (main power supply) 31 to generate a main voltage having a predetermined main frequency and a predetermined amplitude, and a first impedance matching circuit 33 to impedance-match the main voltage;

a second RF generator (bias power supply) 32 to generate a bias voltage having a predetermined bias frequency and a predetermined amplitude and a second impedance matching circuit 34 to impedance-match the bias voltage; and

a high frequency mixer 35 connected to both impedance matching circuits 33, 34 that receives and mixes the main voltage and the bias voltage, and outputs the mixed voltage to the lower electrode 16 (Paragraph 0034).

Wikuramanayaka do not teach an auxiliary power supply comprising an auxiliary power source and a third impedance matching circuit.

Aoki et al teach a plasma apparatus (Figures 1C, 14A) that includes a plasma reaction container 502 and upper electrode 103 to which RF power is supplied. Aoki et al further teach that apparatus includes three power sources 110A, 110B, 801 (like main, bias and auxiliary power supplies) and three corresponding matching networks 112A, 112B and 802 whose output power of predetermined frequencies and amplitudes is synthesized (mixed) and then branched and supplied to upper electrode 103 (paragraphs 0533 –0537).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to mix power from three power sources with three matching networks and supply mixed power to one of the electrodes as taught by Aoki et al in the apparatus of Wikuramanayaka to achieve improved evenness of standing wave suppression effect (paragraphs 0081, 0082).

Regarding Claims 3, 4: Wikuramanayaka teaches that the high frequency mixer 35 combines the outputs of the first and second RF generators 31, 32 supplies 114 and 116 by superimposing (adding) and which is then coupled to the lower electrode 106 for supplying a superimposed power of the two frequencies coming from the first and second high frequency power supplies 122, 128 respectively (Paragraphs 0020, 0034, 0035).

Regarding Claims 5, 6: Wikuramanayaka teaches that frequency of one RF generator is in VHF range and of the other one is in HF range (Paragraphs 0022, 0034).

Claim 7 is are rejected under 35 U.S.C. 103 (a) as being unpatentable over Wikuramanayaka (JP Pub. No. 2002-246368) in view of Aoki et al (US PGPUB No. 2003/0049558) and Quon et al (US PGPUB No. 2003/009/4239).

Regarding Claim 7: Wikuramanayaka in view of Aoki et al teach all limitations of the claim as explained above including that output voltage of mixer would inherently include a portion for generating plasma that would depend upon the amplitude and frequency of the main voltage and another portion for adjusting the process (etching) condition as per equation given on page 9, lines 2, 3 of the specification.

Wikuramanayaka in view of Aoki et al do not teach that the mixer prevents the main power source, the bias power source and the auxiliary power source from being directly connected to the lower electrode for simultaneously supplying AC power from the main and bias, and auxiliary power sources to the lower electrode.

Quon et al teach a plasma apparatus 20 (Figure 3A) comprising a process chamber with a wafer supporting chuck (Lower electrode) 18;

a very high frequency generator 14 and a VHF match network 30;

a low frequency RF generator 16 (for bias) and a low frequency RF match network 32;

a combiner circuit (mixer) 34 connected to first and second impedance matching networks 30, 32 and receives and mixes the main and bias voltages and outputs the mixed voltage to lower electrode 18 (Paragraphs 0022, 0023, 0024). Quon et al also teach filters in the combiner circuit (mixer) 34 that prevent the main power source and the bias power source from being directly connected to the lower electrode for

simultaneously supplying AC power from the main and bias power sources to the lower electrode (Quon et al - Paragraph 0024). Additionally, Aoki et al also teach (Figure 1C) that 331, 332, 333 can be used to prevent to prevent power from one power supply to diffract into other power supply (paragraphs 0106-0110).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use filters in the mixer as taught by Quon et al in the apparatus of Wikuramanayaka and Aoki et al et al to prevents the main power source, the bias power source and the auxiliary power source from being directly connected to the lower electrode for simultaneously supplying AC power from the main and bias, and auxiliary power sources to the lower electrode.

Claims 1-7 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Donohoe et al (US Patent No. 6,309,978 B1) in view of Aoki et al (US PGPUB 2003/0049558.

Regarding Claim 1: Donohoe et al teach a plasma chamber 101 (Figure 4) comprising a lower electrode 102 and an upper electrode 103, and used for etching/deposition comprising:

a multi-frequency RF source 114 connected to lower electrode 102 (Column 5, lines 20-38). Donohoe et al further teach that the multi-frequency source 114 (per Figure 6) includes three frequency generators 31, 32, 33 (like main, bias and auxiliary power generators) and which provide discrete (predetermined) frequency and discrete power (predetermined amplitude) levels (Figure 7 and Column 6, lines 14-17). Donohoe et al also teach that apparatus further includes a mixer 37 which combines the output signals of three frequency generators 31, 32, 33 and provides output signal 30 (having a beat

component) to the lower electrode 102. Donohoe et al also teach various generators 31, 32, 33 can provide a spectrum of frequencies /power levels (Column 6, lines 5-25). Donohoe et al do not teach impedance matching circuits.

Aoki et al teach a plasma apparatus (Figures 1C, 14A) that includes a plasma reaction container 502 and upper electrode 103 to which RF power is supplied. Aoki et al further teach that apparatus includes three power sources 110A, 110B, 801 (like main, bias and auxiliary power supplies) and three corresponding matching networks 112A, 112B and 802 whose output power of predetermined frequencies and amplitudes is synthesized (mixed) and then branched and supplied to upper electrode 103 (paragraphs 0533 –0537).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use matching networks between the three power sources and the mixer as taught by Aoki et al in the apparatus of Donohoe et al to enable impedance matching between three power sources and the plasma chamber.

Regarding Claim 2: Donohoe et al teach that plasma generation is facilitated by the multi-frequency RF source 114 that includes three frequency generators 31, 32, 33 whose frequencies interfere with each other to produce beat which produces a modulated-bias plasma and the multi-frequency RF source includes a mixer 37 which combines the output of three frequency generators 31, 32, 33 and supplies the output signal 30 to the lower electrode 102 (Figures 4, 6, 7 and Column 5, lines 25-30).

Regarding Claims 3, 4: Donohoe et al teach that for mixer 37, summing junction (adding) is preferred for the high frequencies used for plasma generation (Column 6, lines 30-35).

Regarding Claims 5, 6: Donohoe et al also teach (Figure 7) that the three frequencies can be different.

Regarding Claim 7: Donohoe et al in view of Aoki et al teach all limitations of the claim including filters in the combiner circuit (mixer) 34 that prevent the main power source and the bias power source from being directly connected to the lower electrode for simultaneously supplying AC power from the main and bias power sources to the lower electrode. Further, the mixed voltage would inherently include a portion for generating plasma that would depend upon the amplitude and frequency of the main voltage and another portion for adjusting the process (etching) condition as per equation given on page 9, lines 2, 3 of the specification.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Rakesh K Dhingra

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